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Soviet Shipbuilding Techniques

The last decade has seen a tremendous development in Soviet shipbuilding techniques. Modernizing changes on a large scale have been made in the shipbuilding industry and in other supporting industries.

Prior to 1951 the Soviet shipbuilding program had been a naval construction program for all practical purposes. Most of the naval vessels were built on the building ways from keel-up, using little or no prefabrication.[1] The oldtime stationary bedding cranes with limited working area and lifting capacity were still being used. A minor exception to this type of construction was the sectional construction of submarines.

The Soviet naval construction program had come to a standstill during World War II. After the war naval vessels up to and including destroyers which had not been damaged during the bombardments were slowly completed, while the large vessels like battleships and battle cruisers were scrapped.

Soviet shipyard facilities, in general, were in poor condition and the allied industries were unable to produce a reasonably good standard of propulsion and auxiliary machinery for ships. Electrical equipment, including cables, was of very inferior quality by Western standards. Many failures in machinery and electrical equipment, both on new-constructed ships and in the shipyard installations, continued to be reported for several years after World War II.

The initial upswing in Soviet shipbuilding technique dates back to about 1946 when the shipyards all over the country were in the process of reconditioning, modernization, and expansion. Building ways were paved, old stationary cranes were replaced with heavy duty traveling cranes, and in most instances adjoining paved subassembly areas were added. New workshops, prefabrication shops, and assembly sheds were built in the major shipyards, and covered building ways and building sites became more common.

Many Soviet shipyards had been employing marine railways for the launching of ships from the building sites[2] instead of using building ways which would require more overall area and length of shoreline. Transferring the vessels from the building sites to the marine railways had been a slow and cumbersome task due to the difference in slopes between the upper and lower part of the marine railways and the slopes of the building sites. The Soviets now developed a hydraulically controlled platform or cradle so the vessel could be built on flat ground and launched over varying slopes and still remain in a nontilt position. The cradle consists of a platform supported by two bogies or trucks, or sets of trucks, which have vertical telescopic tubes fastened

[1] However, destroyers of the LENINGRAD Class had been transported in section to the Far East and assembled in graving docks in Vladivostok. These ships had been constructed at Nikolayev and disassembled into sections for shipment. These destroyers had been constructed in the conventional manner on building ways from keel-up with a small amount of subassemblies such as bow and stern sections.

[2] Marine railways are defined as two or more rails leading down a slope on land into the water with a truck or cradle. This facility is often used for launching ships under control of brakes, as well as for hauling ships for repairs. A side launching way consists of a sled on a set of runners and cannot be used for hauling ships.

to the trucks by hinge pins and bolted to the platform or cradle. The telescopic tubes are controlled to allow the trucks to move on the sloped tracks while the cradle platform always remains horizontal and thus keeps the vessel on an even keel.

From 1946 to 1949, while the shipyards were being reconditioned, the Central Design Office in Leningrad, with a large staff of experienced naval architects and marine engineers, designed the cruisers, destroyers, and submarines for the first big naval construction program after the war. While earlier designs had more or less followed the work of other countries, with some details particularly developed for Russian conditions, postwar Soviet design showed a native technique which had been developed through research and experimentation. Towing tests were conducted in the Soviet model basins, which are considered to be on a par with the best in the Western countries.

The beginning of a merchant ship construction program for oceangoing vessels took place in 1951 when Nosenko Shipyard in Nikolayev built a 12,000-DWT tanker which became the prototype for a series of over 30 tankers.

Although all old shipyard facilities had been reconditioned or replaced by 1949, the Soviets have continued to build new facilities; in fact, entire new modern mass production yards.

The latest development for mass production of large merchant vessels is a new shipyard in Kherson. The outstanding feature of this yard is that all facilities in the shipyard, including assembly and fitting-out ways and launching basin piers, are at ground level. The launching basin is constructed of reinforced concrete bulkheads above ground level. The system of multirails and about 100 trucks required for assembly line construction may have a high initial cost, but it is indeed a time- and cost-saving facility. It is believed that the first tanker built in Nikolayev in 1951 was constructed on new facilities similar to those in Kherson, since this particular yard had only two building ways of suitable size and at that time they were used for cruiser construction. It is further believed that other new facilities will be installed throughout the USSR for mass production of merchant ships, rather than converting old ways which still can serve for construction of large naval vessels.

The construction time for the 12,000-DWT tankers in the shipyard in Kherson has been reduced to 4 months per ship as compared with 12 months using the old method of construction from keel-up. By further development of the prefabrication, and producing complete sections which can be moved to the assembly area, it will be possible to reduce the construction time to 2 months per ship. Prefabrication of complete sections is also used for destroyer and submarine construction, especially when the ships are to be assembled in areas far away from the construction yards. Larger vessels such as the cruisers have not yet obtained the relatively high rate of prefabrication used for construction of smaller vessels, but with the increase of crane capacities larger prefabricated sections can be constructed.

Prefabrication techniques are dependent upon the development of shop facilities and standardization of design and construction. Automatic and semiautomatic machinery is especially designed for the mass production of machinery component parts where accuracy is essential, and the trend is to develop the automatic machinery not only to fabricate individual parts but also to weld subassemblies. There is little information on details of shop equipment in Soviet shipyards other than that some of the latest German machinery has been available, but certain conclusions can be drawn from production data and by comparison with the production of similar type and size vessels built under known conditions.

United States standards for construction of naval vessels and merchant vessels are used for comparison. The average

number of man-hours going into the construction of the various types and sizes of vessels has been obtained from BuShips and the Maritime Administration.

Comparing the time required to construct cruisers of similar size in the United States and in Soviet yards, a comparable scale was computed for the production of cruisers in Baltic and Kryloy Shipyards in Leningrad and for Nosenko Shipyard in Nikolayev. Baltic Shipyard compared directly with average United States shipyards and the other two yards required about 10 percent and 15 percent longer time, respectively, under similar conditions. An average of 10 percent was added to the number of man-hours required under peacetime conditions in United States shipyards as an estimate for the major shipyards in the Soviet Union. Based on the available information on the production time of cruisers in the Leningrad yards, together with photographic interpretation and reports of sectional construction being transported from assembly halls to the building ways, it is concluded that sectional construction of bulkheads, decks, inner bottoms, floors, bows, and sterns is employed in these yards. This amount of prefabrication shows a production of 1.75 times as great as the estimated production would have been using conventional construction without prefabrication under identical conditions with respect to number of workers, supply of material, weather, etc.

Similarly it is estimated that the overall production of submarines at Krasnoe Sormovo Shipyard in Gorki is about 3.25 times as great as without prefabrication. From this it is concluded that the yard is prefabricating very complete hull sections with machinery, piping, and equipment installed in the sections and transported to the assembly site where the sections are welded together, piping connected, line shafts installed, etc.

Through similar analysis of information of other Soviet shipyards it is reasonable to believe that prefabrication is generally employed in all major shipyards.

Weight handling facilities are systematically improved to handle larger and heavier subassemblies.

It is interesting to note that Sudomekh Shipyard, which prior to 1952 was the most important submarine construction yard in the Soviet Union, today is an assembly yard for submarines receiving sections constructed by Baltic and Kryloy Shipyards. Today Gorki is the outstanding submarine construction yard and besides having covered building sites for the simultaneous construction of 13 submarines of the "W" Class, has additional open air sites which can accommodate 10 "W" Class submarines. A winch house is located in the vicinity of these additional sites, which could indicate that submarines or other vessels may be hauled up for repairs or mass conversions. This facility can also be used for construction of ships.

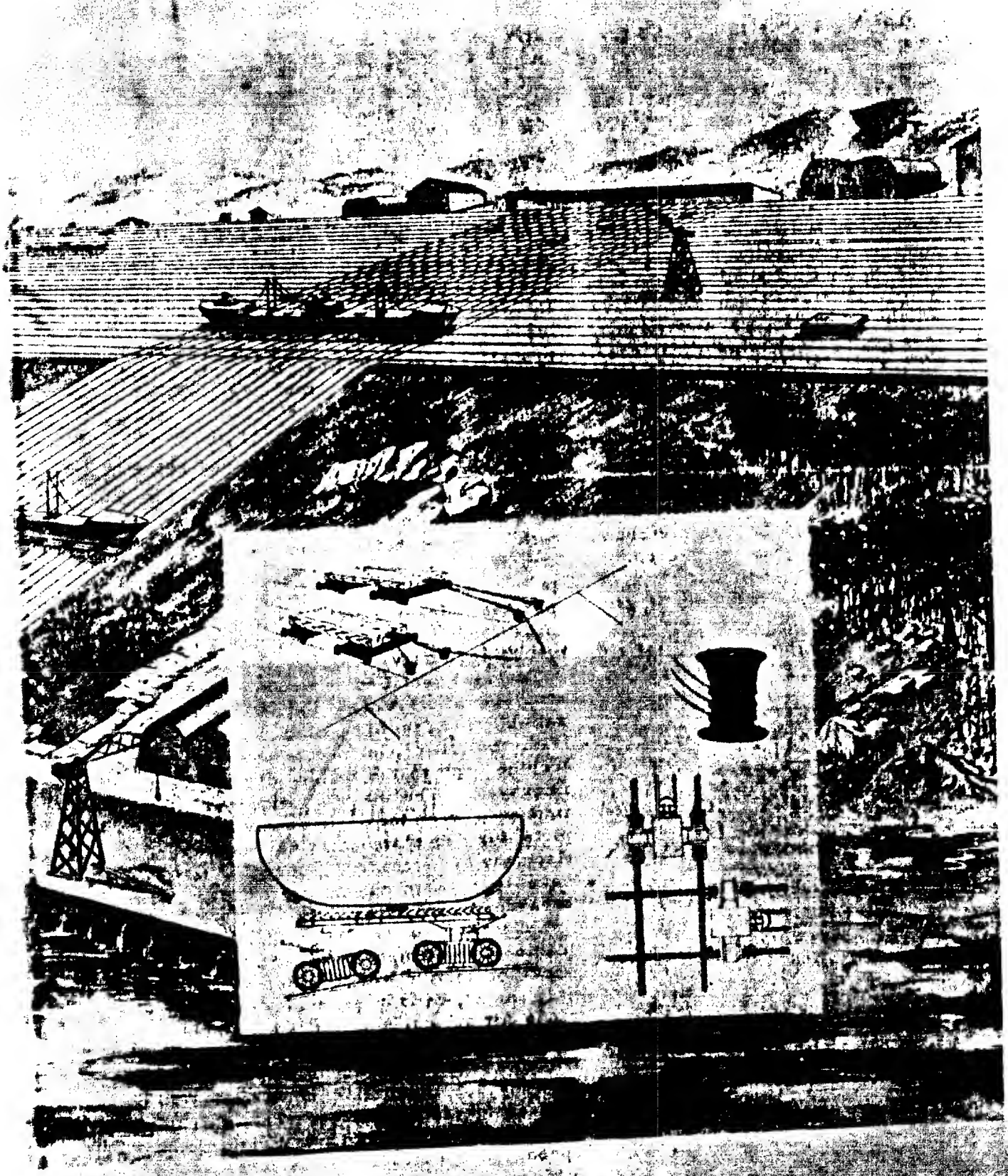
Assembly line construction of submarines is used in Nosenko Shipyard in Nikolayev and the required construction time may be estimated to be one-fifth of that required to construct the identical craft on the building ways without using prefabrication.

Photo-lofting is used by some of the Soviet shipyards and is well suited to the Soviet system of centralization of design and standardization of construction.

Welding has been developed by Soviet shipyards to make it possible to weld under low temperatures with the aid of induction heat. The outdoor welding has been reduced to a minimum by the use of prefabrication and subassembly which generally employs machine welds. Welding by hand is therefore generally limited to welding of section joints. Special rotating jigs which can accommodate sections up to 50 feet are used to facilitate the welding.

The hand welding has been reported to show poor workmanship, because the rough beads had not been ground down to make a smooth surface on the shell plating.

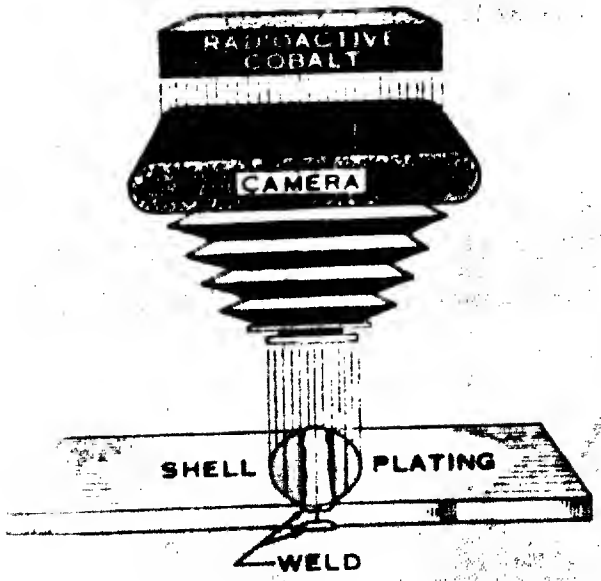
The ships in reference were of the SVERDLOV and SKORYY Classes. Al-



though most Western shipyards do grind the welds to a smooth shell surface it is not necessarily poor workmanship to leave the welds rough. It is more a question of appearance than of strength and efficiency with respect to the resistance of the hull in the seaway. The Soviet requirements for welding of ships as shown in the Soviet Sea Register is as strict as Western rules. Their inspection is carried out with the most modern equipment. The Russians control the welding of shell plating with the help of radiation from radioactive cobalt which is a more convenient method than X-ray photography in many instances. Material control by gamma rays is now in general use in most industries in the USSR.

Thicknesses of platings are checked with ultrasonic resonance gauges where accurate measurements are required without having to drill holes in the plates.

The Soviet Sea Register for merchant ships also requires greater strength in the plating amidships, including stringer plates, sheer strakes, and one or two strakes below the sheer strakes depending on the depth of the vessel. The ultimate tensile strength of steel called "Aldur 50" which the Soviets obtain from Austria, and which meets the requirements, is about 25 percent higher than that of Class "B" steel which is used in the United States. The minimum yield point is almost 60 percent higher than that of Class "B" steel. "Aldur 50" is not always available in quantities and a steel named "Union 56" made by Union Hörde, Dartmund, Germany, is often substituted for it. This steel has properties equivalent to "Aldur 50" and is cheaper. However, special electrodes are needed for "Union 56" steel. The requirements for the rest of the shell plating of the ships are about the same as United States requirements.



Soviet armor plating for naval vessels is generally considered to be on a par with or even better than United States armor plating. Tensile strength is adequate for deep submergence of submarines. Special requirements are also made for naval and merchant vessels operating in heavy ice.

Turbines installed in cruisers and destroyers after World War II were unreliable and caused constant breakdowns. With the aid of German technicians and turbine experts the turbine designs were improved. The manufacturing was also improved when the Soviets moved a complete turbine manufacturing plant from Germany to Leningrad. Today the "bugs" have been taken out of the turbines and breakdowns are seldom reported.

There are six known manufacturers of marine diesel engines in the USSR. Kuybyshev Locomotive Works in Kolomna is the only one known to be producing diesel engines for submarines, but is estimated to have the capacity of producing all the engines required to supply the maximum capacity for submarine construction as well as for replacements. This plant is also manufacturing heavy-duty, slow-speed, marine diesel engines. The largest engine manufactured for a merchant ship

developed 6,600 BHP at 125 r.p.m., but none larger than about 2,000 BHP have been placed in mass production. The engines for the first 12,000-DWT tanker KAZBEK were two 1,400-BHP German diesel engines. The next 32 tankers of the same class received 2,000-BHP units.

Diesel engine research and design work is being done at the Kuybyshev Locomotive Works in collaboration with the Research Institute for Diesel Engines in Leningrad and the Central Design Bureau of the Ministry of Shipbuilding.

Experimental work was conducted with closed-cycle Walther turbines after World War II and an experimental prototype may have been launched in 1955. There is no indication, however, that development progressed to the production of operational boats.

Hydrofoil boats have been developed and PT-boat size vessels may be in production by 1957.

There are indications that the Soviets are designing and are possibly already constructing an atomic powerplant on board at least one large vessel of about 16,000 or 25,000 tons displacement. This plant is believed to be very similar to their developed land plants, which consist of reactors having low-percentage fuel rods and operating with low-pressure turbines, probably with saturated steam of about 250 pounds per square inch.

It is not known whether nuclear-propelled submarines have been under construction nor have any construction plans been divulged. There are, however, indications that research on reactors suitable for use in submarines is in progress in the USSR and that these could be installed in a submarine ready for commission before the end of 1957.

The Soviet shipbuilding know-how has been vastly improved since World War II. With the interest shown by the government to develop and encourage ship designers and with the German technical personnel and the experience obtained from recent naval construction, Soviet shipbuilding today rates among the leading shipbuilding industries in the world.